Coastal Upwelling off South America During the 1997 – 1998 El Niño

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Off the coast of Peru, the El Nino phenomenon is a remarkable reoccurrence of warmer-than-normal ocean waters with a thickness of 50-100 m. The question, How does the near-surface lens of warm water remain in the coastal zone?, will be addressed. In the eastern equatorial zone of the Pacific, the intrusion of the near-surface warm layer during the El Nino is made possible by the lowering of the thermocline, which is created by a weakening of the prevailing westward wind stress. However, an analogous mechanism does not apply for the coastal region off Peru, where the prevailing equatorward wind stress becomes enhanced during El Nino, which would further uplift the already-uplifted coastal thermocline. Accompanying the invasion of warm surface waters is a reversal in direction of the wind stress curl vertical velocity at the bottom of the Ekman layer, which was computed from satellite ocean vector wind measurements. During El Nino, this vertical motion is downward with considerable magnitude, which is believed to deepen the thermocline to allow buildup of the anomalous thick warm mixed layer. The proposed mechanism represents an example of multi-month wind-driven ocean response that has a tremendous societal influence.